

AMENDMENT TO THE CLAIMS

The following is a detailed listing of all claims that are, or were, in the Application.

1-11. (Cancelled)

12. (Currently amended) A charge pumping system capable of a forward operation mode and a reverse operation mode, wherein in forward operation mode the charge pumping system can step-up an input voltage at a ratio of $\frac{1}{2}:1$ and can step-down the input voltage at a ratio of $n:m$ where n and m are both integer values and n is equal to or greater than m , and wherein in reverse operation mode the charge pumping system can step-down the input voltage at a ratio of $1:\frac{1}{2}$ and $1:1$ and can step-up the input voltage at a ratio of $p:q$ where p and q are both integer values and p is less than q , comprising a circuit for automatically assigning the charge pumping system to function in the forward operation mode or the reverse operation mode based at least in part on the input voltage.

13. (Original) The system of claim 12 comprising:

a first node operable to be connected as either an input node or as an output node for the system; and

a second node operable to be connected as either an input node or as an output node for the system.

14. (Original) The system of claim 12 comprising a switching component operable to be configured to set the ratio for step-up or step-down for the forward and reverse operation modes.

15. (Original) The system of claim 14 wherein the switching component comprises a plurality of switching elements, at least a portion of the switching elements each comprising a fractional switch.

16. (Original) The system of claim 15 wherein each fractional switch comprises a plurality of segments, each segment operable to be individually turned on and off.

17. (Original) The system of claim 15 further comprising a control circuitry for turning on and turning off the switching elements.

18. (Original) The system of claim 12 wherein the system is implemented in a single monolithic semiconductor die.

19. (Currently amended) A charge pumping system capable of a forward operation mode and a reverse operation mode, the system comprising:

a first node operable to be connected as an input node in the forward operation mode and as an output node in the reverse operation mode;

a second node operable to be connected as an input node in the reverse operation mode and as an ~~input~~ output node in the forward operation mode;

wherein in forward operation mode the charge pumping system can step-up an input voltage at a ratio of $\frac{1}{2}:1$ and can step-down the input voltage at a ratio of $n:m$ where n and m are both integer values and n is equal to or greater than m , and wherein in reverse operation mode the charge pumping system can step-down the input voltage at a ratio of $1:\frac{1}{2}$ and $1:1$ and can step-up the input voltage at a ratio of $p:q$ where p and q are both integer values and p is less than q ; and

a switching component connected to the first node and the second node, the switching component operable to be configured to set the ratio for step-up or step-down for the forward

and reverse operation modes, the switching component comprising at least one fractional switch having a plurality of segments; and

a circuit for automatically assigning the charge pumping system to function in the forward operation mode or the reverse operation mode based at least in part on the input voltage.

20. (Original) The system of claim 19 further comprising a control circuitry for turning on one or more segments of the fractional switch.

21. (Original) The system of claim 20 wherein the control circuitry implements a PFM technique to turn on the segments.

22. (Original) The system of claim 19 wherein the system is implemented in a single monolithic semiconductor die.

23. (Original) A charge pumping system operable to be connected among a plurality of terminals for functioning in a step-up/step-down operation and, without changing the connection among the plurality of terminals, for functioning in a step-down/step-up operation.

24. (Original) The charge pumping system of claim 23 wherein in the step-up/step-down operation the charge pumping system can step-up an input voltage at a ratio of $\frac{1}{2}:1$ and can step-down the input voltage at a ratio of $n:m$ where n and m are both integer values and n is equal to or greater than m , and wherein in the step-down/step-up operation the charge pumping system can step-down the input voltage at a ratio of $1:\frac{1}{2}$ and $1:1$ and can step-up the input voltage at a ratio of $p:q$ where p and q are both integer values and p is less than q .

25. (Original) The charge pumping system of claim 24 comprising a switching component operable to be configured to set the ratio for step-up or step-down during step-up/step-down operation and during step-down/step-up operation.

26. (Original) The charge pumping system of claim 25 wherein the switching component comprises a plurality of switching elements, each switching element operable to be adjustably turned on depending upon load conditions for the charge pumping system, thereby providing better power efficiency.

27. (Original) The charge pumping system of claim 23 wherein the system is operable to automatically determine whether to function in the step-up/step-down operation or the step-down/step-up operation based on the respective voltage potentials at the various terminals.

28. (Original) The charge pumping system of claim 23 further comprising a circuit for automatically assigning the system to function in the step-up/step-down operation or the step-down/step-up operation based on the respective voltage potentials at the various terminals.

29. (Original) A charge pumping system operable to be connected among a plurality of terminals for functioning in a step-up/step-down operation and, without changing the connection among the plurality of terminals, for functioning in a step-down/step-up operation, the system comprising:

a switching component operable to regulate the charge pumping system in the step-up/step-down operation and in the step-down/step-up operation; and

a circuit for automatically assigning the system to function in the step-up/step-down operation or the step-down/step-up operation based on the respective voltage potentials at the various terminals.

30. (Original) The charge pumping system of claim 29 wherein in the step-up/step-down operation the charge pumping system can step-up an input voltage at a ratio of $\frac{1}{2}:1$ and can step-down the input voltage at a ratio of $n:m$ where n and m are both integer values and n is equal to or greater than m , and wherein in the step-down/step-up operation the charge pumping system can step-down the input voltage at a ratio of $1:\frac{1}{2}$ and $1:1$ and can step-up the input voltage at a ratio of $p:q$ where p and q are both integer values and p is less than q .

31. (Original) The charge pumping system of claim 29 wherein the switching component comprises a plurality of switching elements, each switching element operable to be adjustably turned on depending upon load conditions for the charge pumping system, thereby providing better power efficiency.

32. (Original) The charge pumping system of claim 31 further comprising a control circuit for turning on one or more switching elements of the switching component.

33. (Original) The charge pumping system of claim 29 wherein the system is implemented in a single monolithic semiconductor die.

34. (Original) A switching component for a charge pumping system, the switching component operable to be connected among a plurality of terminals for regulating the charge pumping system in a step-up/step-down operation and, without changing the connection among the plurality of terminals, for regulating the charge pumping system in a step-down/step-up operation.

35. (Original) The switching component of claim 34 comprising a plurality of switching elements, each switching element operable to be adjustably turned on depending upon load conditions for the charge pumping system, thereby providing better power efficiency for the charge pumping system.

36. (Original) The switching component of claim 34 comprising a plurality of switching elements, wherein at least a portion of the switching elements are implemented as fractional switches.

37. (Original) The switching component of claim 36 wherein each fractional switch comprises a plurality of segments connectable in parallel between a first node and a second node, each segment operable to be individually turned on and off, wherein the number of segments which are turned on at a given moment is varied depending on loading conditions between the first and second nodes.

38. (Original) A fractional switch for connection between a first node and a second node, the fractional switch comprising a plurality of segments connectable in parallel between the first and second nodes, each segment operable to be individually turned on and off, wherein the number of segments which are turned on at a given moment is varied depending on loading conditions between the first and second nodes.

39. (Original) The fractional switch of claim 38 wherein each segment comprises a transistor and wherein the transistors for the various segments are different sizes.

40. (Original) The fractional switch of claim 38 wherein the plurality of segments comprises a first segment, a second segment, and a third segment.

41. (Original) The fractional switch of claim 40 wherein the first segment comprises a small-sized transistor, the second segment comprises a medium-sized transistor, and the third segment comprises a large-sized transistor.

42. (Original) A fractional switch for adjusting the flow of current between a first node and a second node, the fractional switch comprising:

- a first transistor connected between the first and second nodes, the first transistor having a first size;

- a second transistor connected between the first and second nodes, the second transistor having a second size which is larger than the first size; and

- a third transistor connected between the first and second nodes, the third transistor having a third size which is larger than the second size;

wherein the first, second, and third transistors are operable to be individually turned on and off depending on loading conditions between the first and second nodes.